NUCLEAR RESEARCH REACTOR IEA-R1
OPERATION AND UTILIZATION*

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I - INTRODUCTION

The IEA-R1, Figure-1, a lightwater moderated swimming-pool research reactor, MTR type, went critical for the first time on September 16, 1957. After surpassing the main problems and difficulties in the initial cycles of operations the reactor has been operating for about thirty years without a single accident with respect to its safety at the Instituto de Pesquisas Energéticas e Nucleares, IPEN (formerly-IEA), of São Paulo, Brazil. The current fuel is Uranium enriched at ninety-three percent and twenty percent in the isotope U-235. The reactor uses graphite reflectors and was designed to operate at a power of five megawatts, but currently has been operating at 2 Mw.

A crew of three to four men permits reactor operation on an eight-hour per day schedule five days per week. The total operating staff consists of seventeen people of which four are graduate supervisors and thirteen are technicians. The team that operates the reactor belongs to the Reactor and Nuclear Experiment Division (REN), which is also in charge of water treatment and purification, orientation and supervision of the utilization of irradiation facilities. The setting fo two Division compose the Department of Reactor and Experimental Circuit (RE) that belongs to the Reactors Directory (R) of IPEN-CNEN/SP.

In a general way, in these thirty years the principal aim to be reached with the reactor utilization has been the development of academical research performed mainly by the two

Divisions that have their staffs permanently located near the reactor facilities: the Radiochemistry Division (TFR) and the Nuclear Physics Division (TPF). More recently the Reactor Physics Division (RTF) has used the reactor for experiments in reactor physics parameters. Nevertheless, as a by product of these research activities it was possible to reach a condition where services to the scientific community and also to industry, can be offered by the Institute. The reactor has been used practically without interruption by users of IPEN, of other Institutes and of industrial organizations as well as the several scientific papers developed in the field of basic and applied research have been used for personnel training purposes such as master and doctoral thesis publications. More specifically, since the beginning of the reactor operation, besides sealed sources production for industrial applications, sample irradiations were carried out for the production of radioisotopes to be applied in the IPEN researches and for external supply; neutron activation analysis of several materials were frequently made. A large number of scientifc papers were published on the field of Radiochemistry and also in Neutron Physics, in this case using neutron beams collimated through the reactor beam holes.

II - OPERATIONAL EXPERIENCE AND PROBLEMS[1]

Besides the reactor maintenance the setting in compliance with the more recent safety regulatory guide, the renewal and power upgrading programmes of research reactors must aim the obtention of higher and better quality neutron fluxes, in order to attend the evaluation of the different user's needs.

The majority of the world's research reactors, which were designed and built up fifteen or twenty years ago, are still being used; it is obvious that many components had to be replaced since they became obsolete. The development in the control and instrumentation systems were particularly rapid, leading to the greatest modifications in the existing instalations. Nevertheless, more than the simple change of the individual components through the years, the subjects to be addressed when considering either a new research reactor, the modernization or the upgrading of an existing plant are much

wider than simply the selection and design of the modification or extension itself. Ideally, the opportunity should be taken to review the safety basis of the system as a whole, in order to ensure that not only the operational parameters are improved, but also the current Safety Criteria and integrity of the whole system. It is of great importance to consider a more extensive renewal programme for the installation as a whole in order to have economic and safe reactor operations for another twenty years or more.

III - EXPERIMENTAL FACILITIES[1]

The schematic diagram of the reactor core and the positions of some experimental samples irradiation facilities are shown in Figure-2.

IV - REACTOR UTILIZATION[1]

IV.1 - Radiochemistry Research

The Radiochemistry Division of IPEN is in charge of the development of experiments in several branches of research in the fields of Radiochemistry and Neutron Activation Analysis. Its staff is, presently, constituted by 12 researches being seven Doctors, two Masters in Science and three candidates for a M.Sc. degree. The Division is installed near the IEA-R1 reactor building and utilizes almost exclusively two of the four available pneumatic rabbit stations for sample irradiation. The Division was pioneer concerning the IEA-R1 research reactor utilization because since the beginning of the reactor operations it has been presenting profitable scientific performance as can be seen by observing the large number and the quality of the scientific papers prepared during the last thirty years.

IV.2 - Nuclear Physics

The staff of the IPEN Nuclear Physics Division has under its responsibilities the development of experiments and studies in the following main fields of research: Neutron Physics, Nuclear Reactions and Nuclear Metrology.

IV.3 - Reactor Physics

The IEA-R1 research reactor has been used by the Reactor.

Physics Division of IPEN for developing of methods for measurements of nuclear reactor parameters, using differents techniques,like:noise analysis, reactmeter and fission chamber miniature detector for neutron flux measurement.

REFERENCES*

1. FULFARO, R; SOUZA, J.A.; NASTASI, M.J.C.; VINHAS, L.A.; LIMA, F.W. Experience and research with the IEA-R1 Brazilian Reactor. São Paulo, Instituto de Pesquisas Energéticas e Nucleares, Junho 1982 (IPEN-Pub-43).

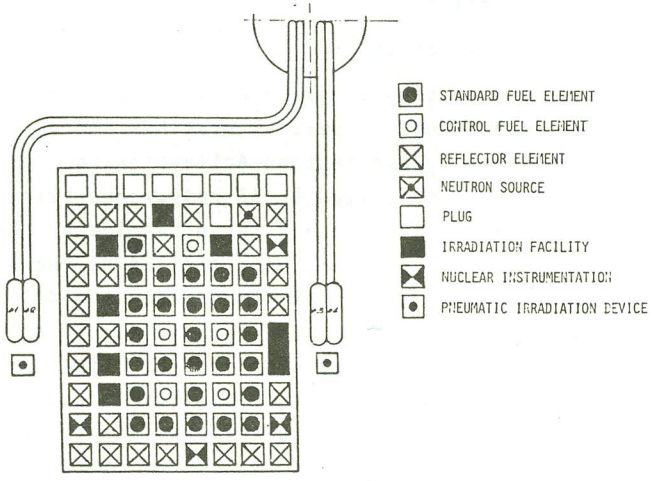

Figure 2 - Reactor Mapping Core with Irradiation Facilities

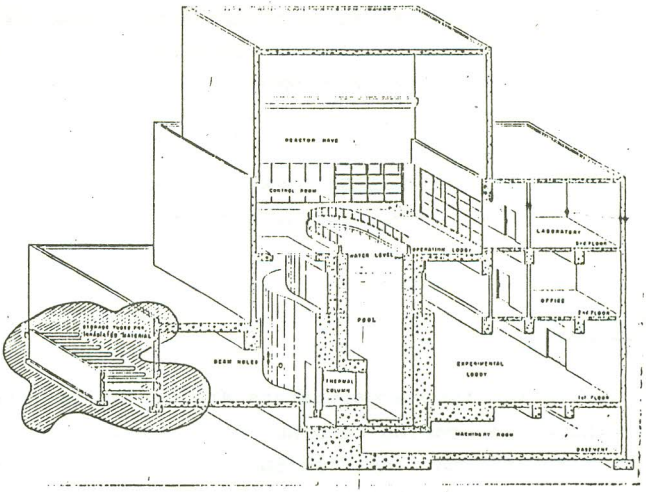

Figure 1 - Cross-Section of IEA-R1 Reactor Building

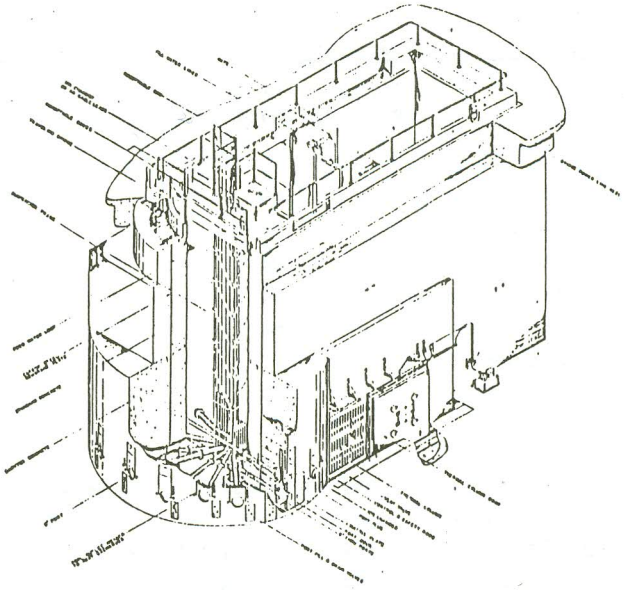

Figure 1a - Isometric View of IEA-R1 Research Reactor